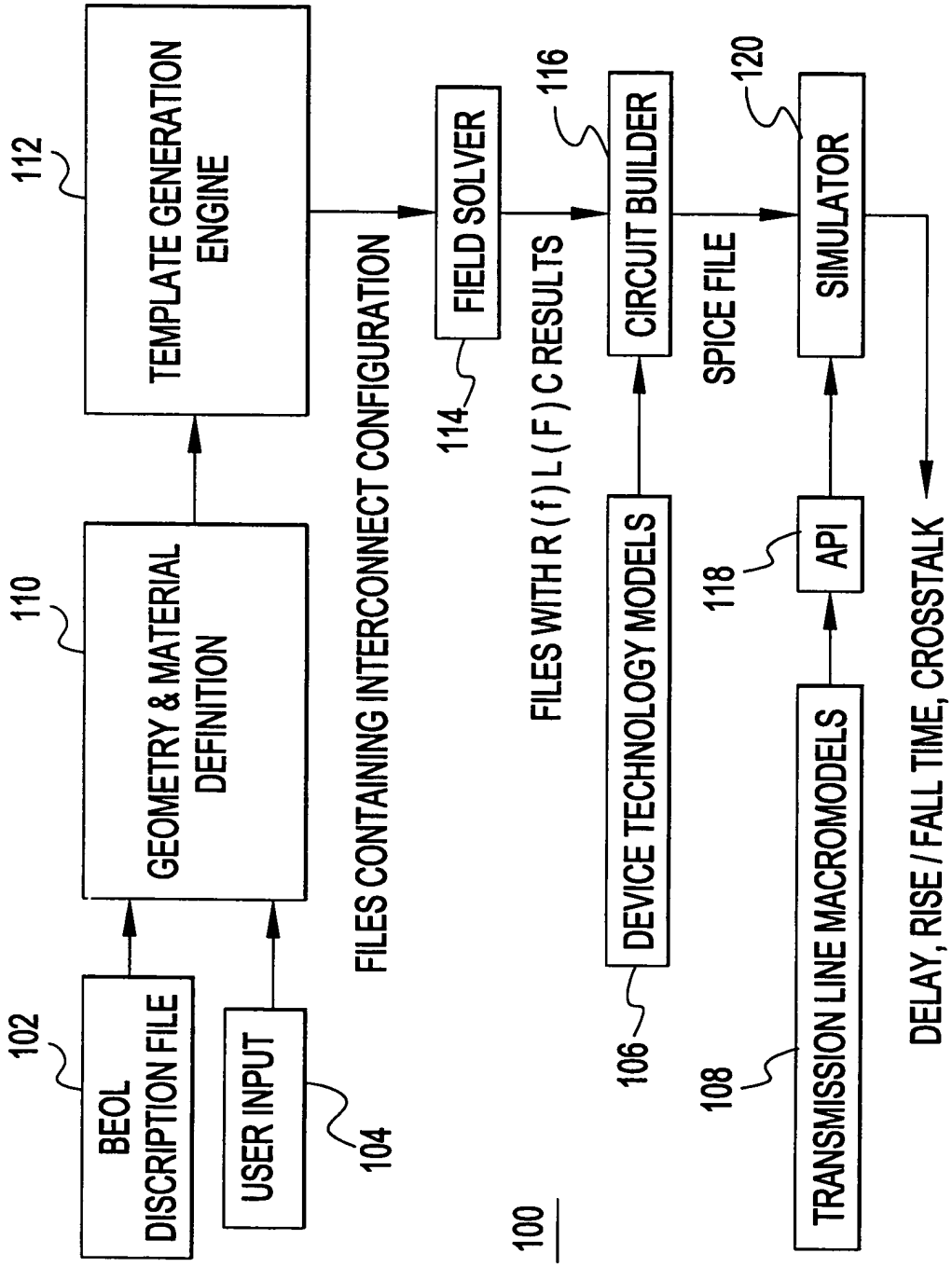

100
102
BEOL DISCRIPTION FILE
104
USER INPUT
110
GEOMETRY & MATERIAL DEFINITION
112
TEMPLATE GENERATION ENGINE
FILES CONTAINING INTERCONNECT CONFIGURATION
114
FIELD SOLVER
FILES WITH R (f) L (F) C RESULTS
116
CIRCUIT BUILDER
106
DEVICE TECHNOLOGY MODELS
SPICE FILE
118
API
120
SIMULATOR
108
TRANSMISSION LINE MACROMODELS
DELAY, RISE / FALL TIME, CROSSTALK

FIG.1

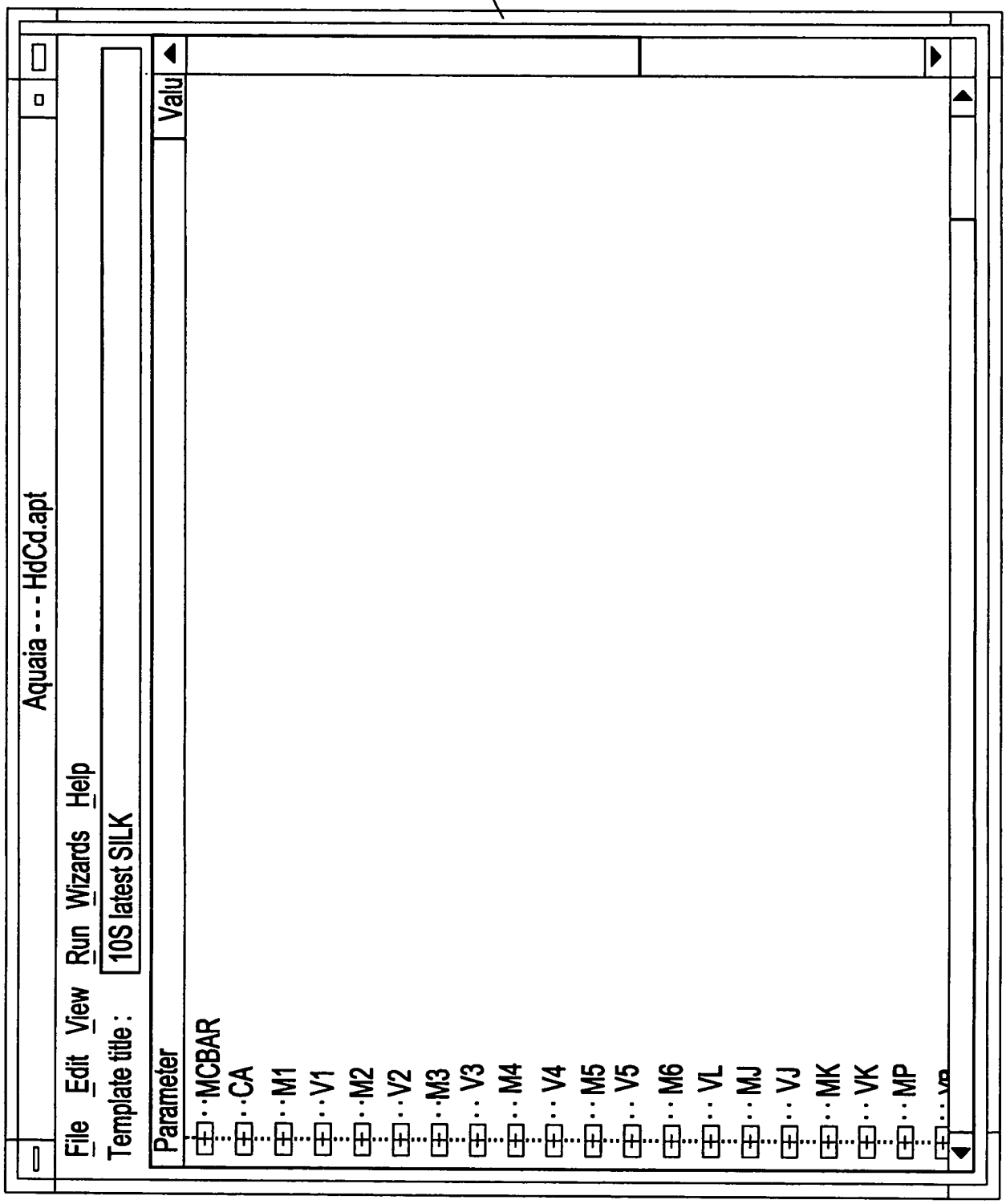

130
Aquaia - - - HdCd.apt
File Edit View Run Wizards Help
Template title :
10S latest SILK
Parameter
Valu
MCBAR
CA
M1
V1
M2
V2
M3
V3
M4
V4
M5
V5
M6
VL
MJ
VJ
MK
VK
MP

FIG.2A

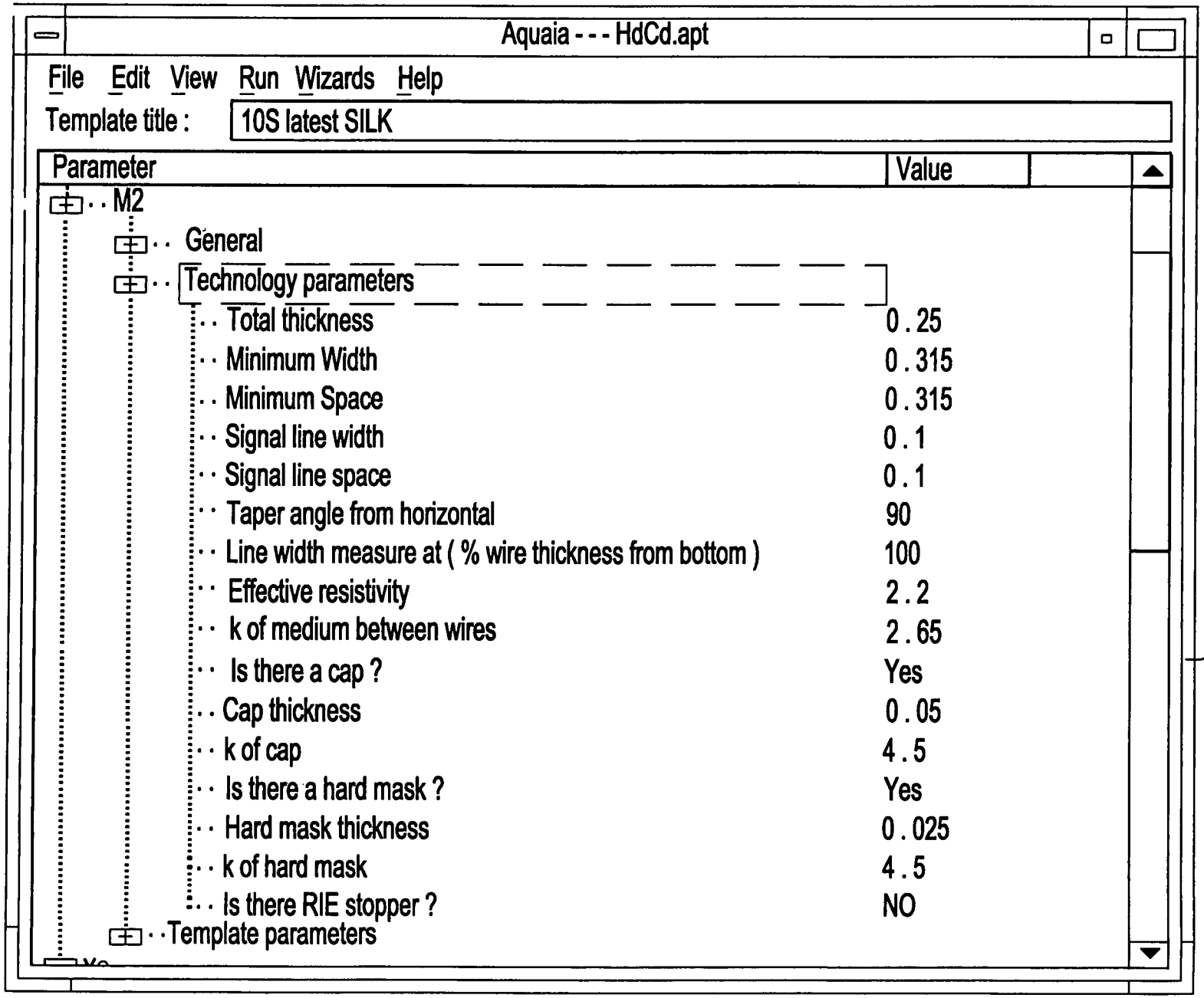

Aquaia - - - HdCd.apt
File Edit View Run Wizards Help
Template title :
10S latest SILK
Parameter
Value
M2
General
Technology parameters
Total thickness 0.25
Minimum Width 0.315
Minimum Space 0.315
Signal line width 0.1
Signal line space 0.1
Taper angle from horizontal 90
Line width measure at (% wire thickness from bottom) 100
Effective resistivity 2.2
k of medium between wires 2.65
Is there a cap ? Yes
Cap thickness 0.05
k of cap 4.5
Is there a hard mask ? Yes
Hard mask thickness 0.025
k of hard mask 4.5
Is there RIE stopper ? NO
Template parameters
132

FIG.2B

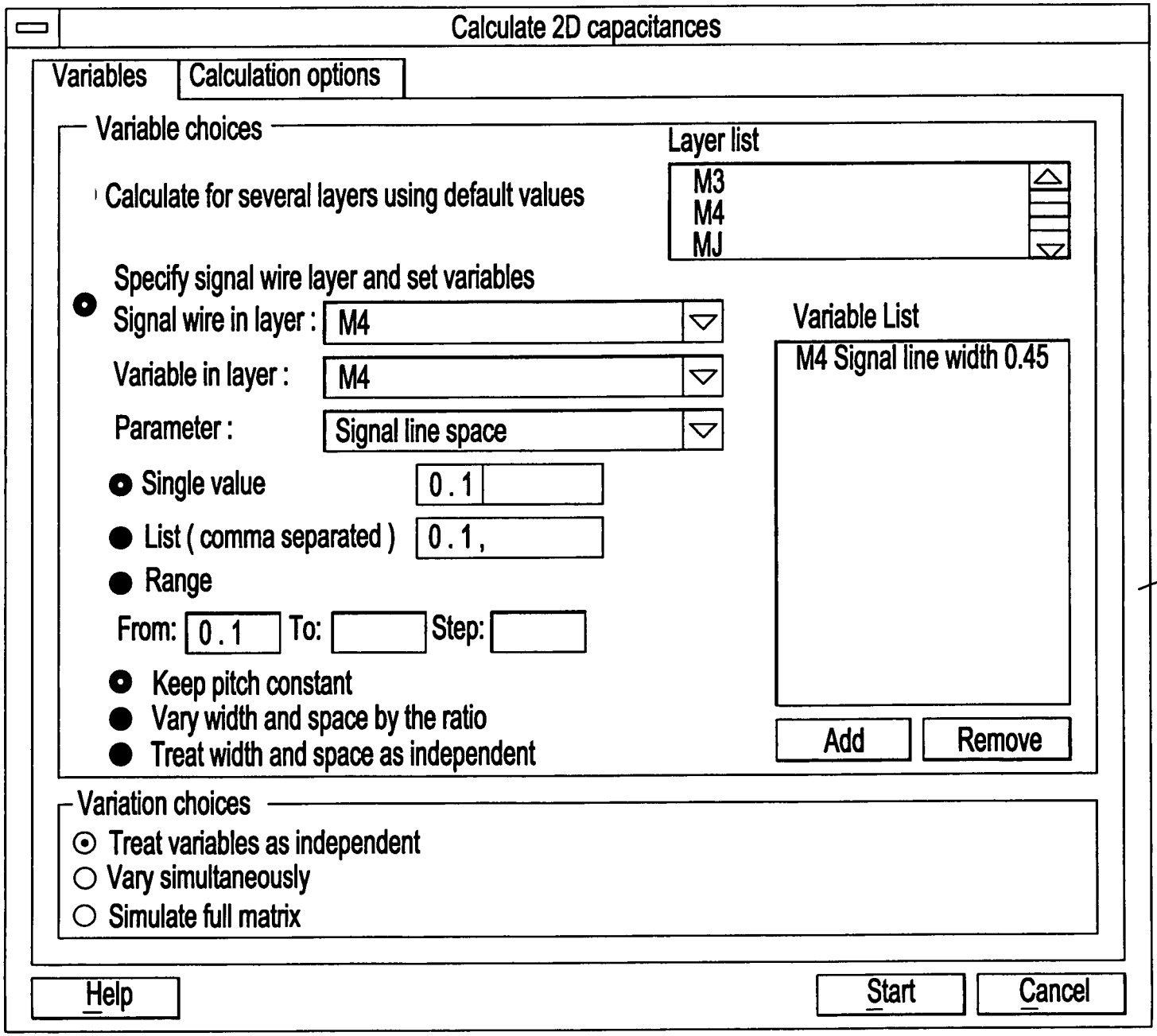

Calculate 2D capacitances
Variables
Calculation options
Variable choices
Layer list
Calculate for several layers using default values
M3
M4
MJ
Specify signal wire layer and set variables
Signal wire in layer :
M4
Variable in layer :
M4
Parameter :
Signal line space
Single value
0.1
List (comma separated)
0.1,
Range
From:
0.1
To:
Step:
Keep pitch constant
Vary width and space by the ratio
Treat width and space as independent
Variable List
M4 Signal line width 0.45
Add
Remove
Variation choices
Treat variables as independent
Vary simultaneously
Simulate full matrix
Help
Start
Cancel
134

FIG.3A

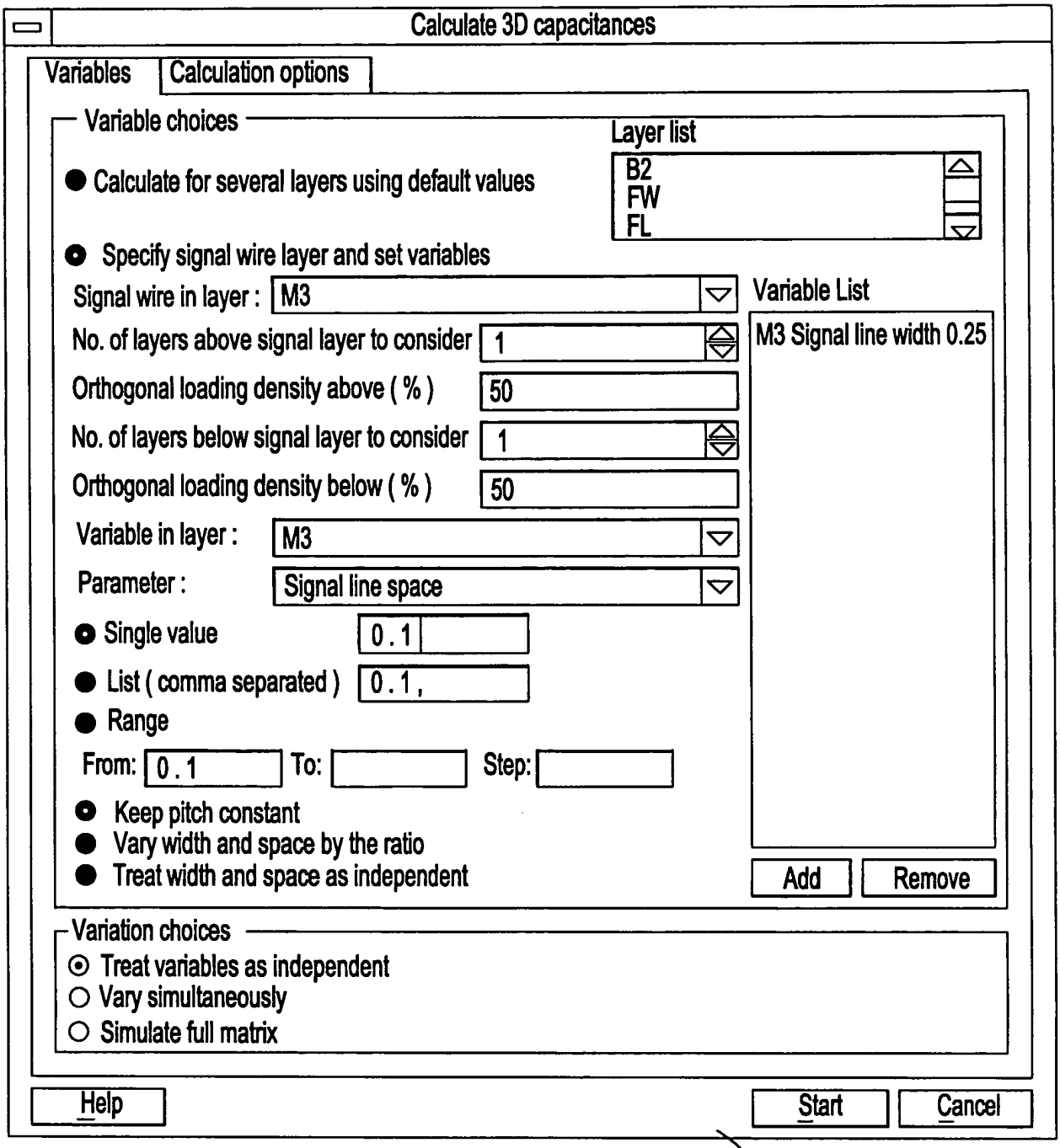
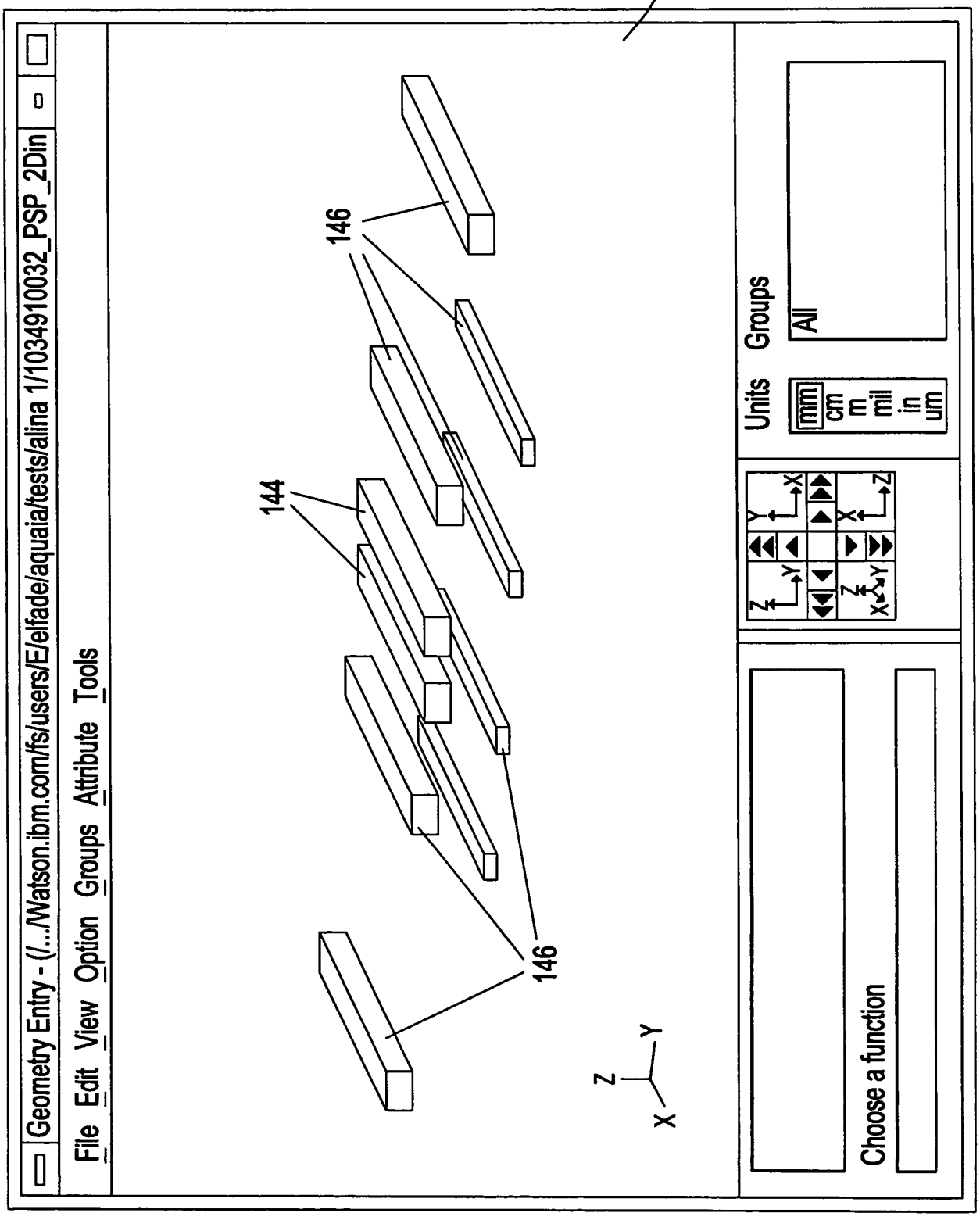

Calculate 3D capacitances
Variables
Calculation options
Variable choices
Layer list
Calculate for several layers using default values
B2
FW
FL
Specify signal wire layer and set variables
Signal wire in layer :
M3
Variable List
No. of layers above signal layer to consider
1
M3 Signal line width 0.25
Orthogonal loading density above (%)
50
No. of layers below signal layer to consider
1
Orthogonal loading density below (%)
50
Variable in layer :
M3
Parameter :
Signal line space
Single value
0.1
List (comma separated)
0.1,
Range
From:
0.1
To:
Step:
Keep pitch constant
Vary width and space by the ratio
Treat width and space as independent
Add
Remove
Variation choices
Treat variables as independent
Vary simultaneously
Simulate full matrix
Help
Start
Cancel
136

FIG.3B

FIG.4A


Geometry Entry - (/.../Watson.ibm.com/fs/users/E/elfade/aquaia/tests/alina 1/1034910032_PSP_2Din
File Edit View Option Groups Attribute Tools
138
144
146
146
Z
Y
X
Units
Groups
All
mm
cm
m
mil
in
um
Choose a function

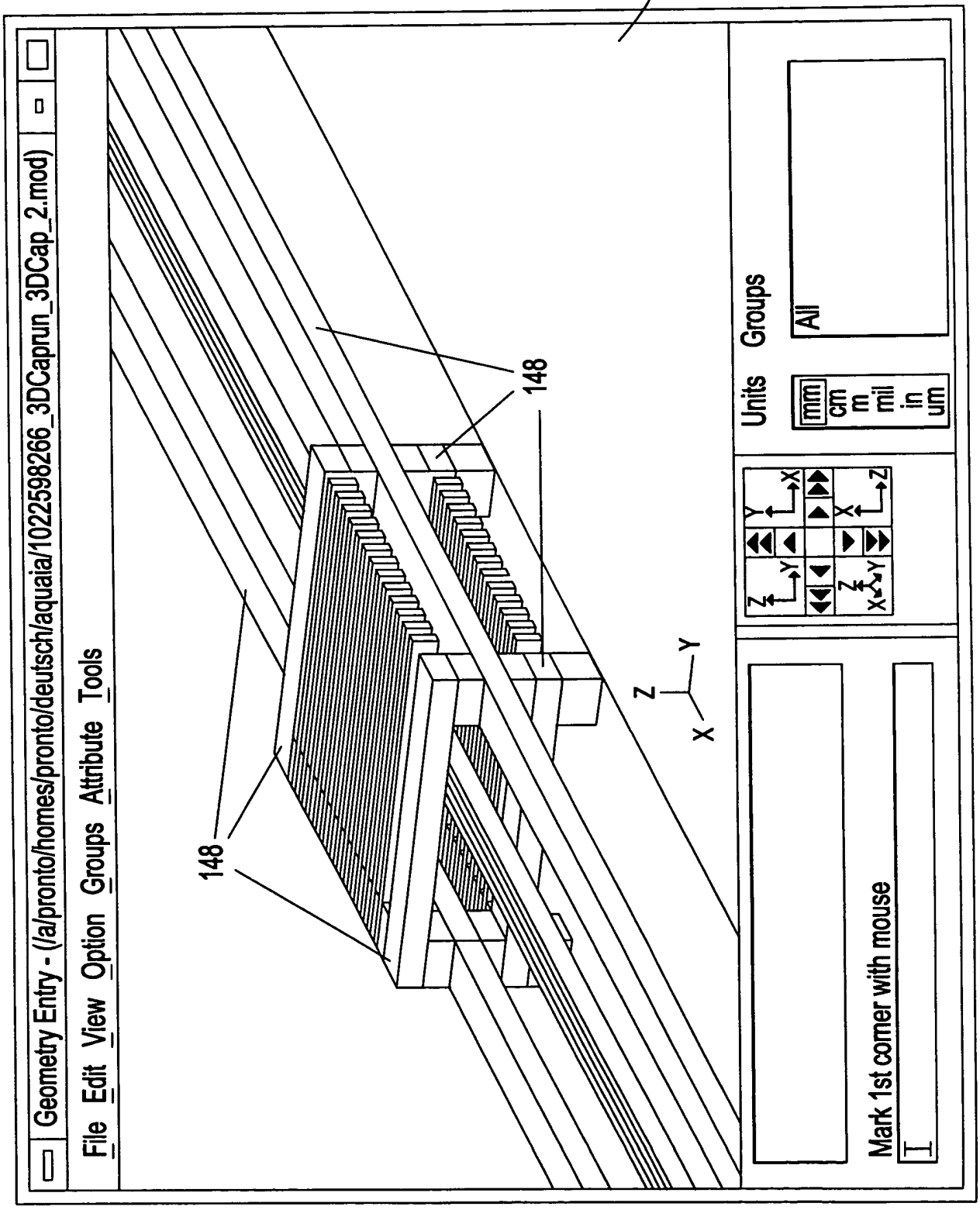

Geometry Entry - (/a/pronto/homes/pronto/deutsch/aquaia/1022598266_3DCaprun_3DCap_2.mod)
File Edit View Option Groups Attribute Tools
148
148
140
Z
Y
X
Units
mm
cm
m
mil
in
um
Groups
All
Mark 1st corner with mouse

FIG.4B

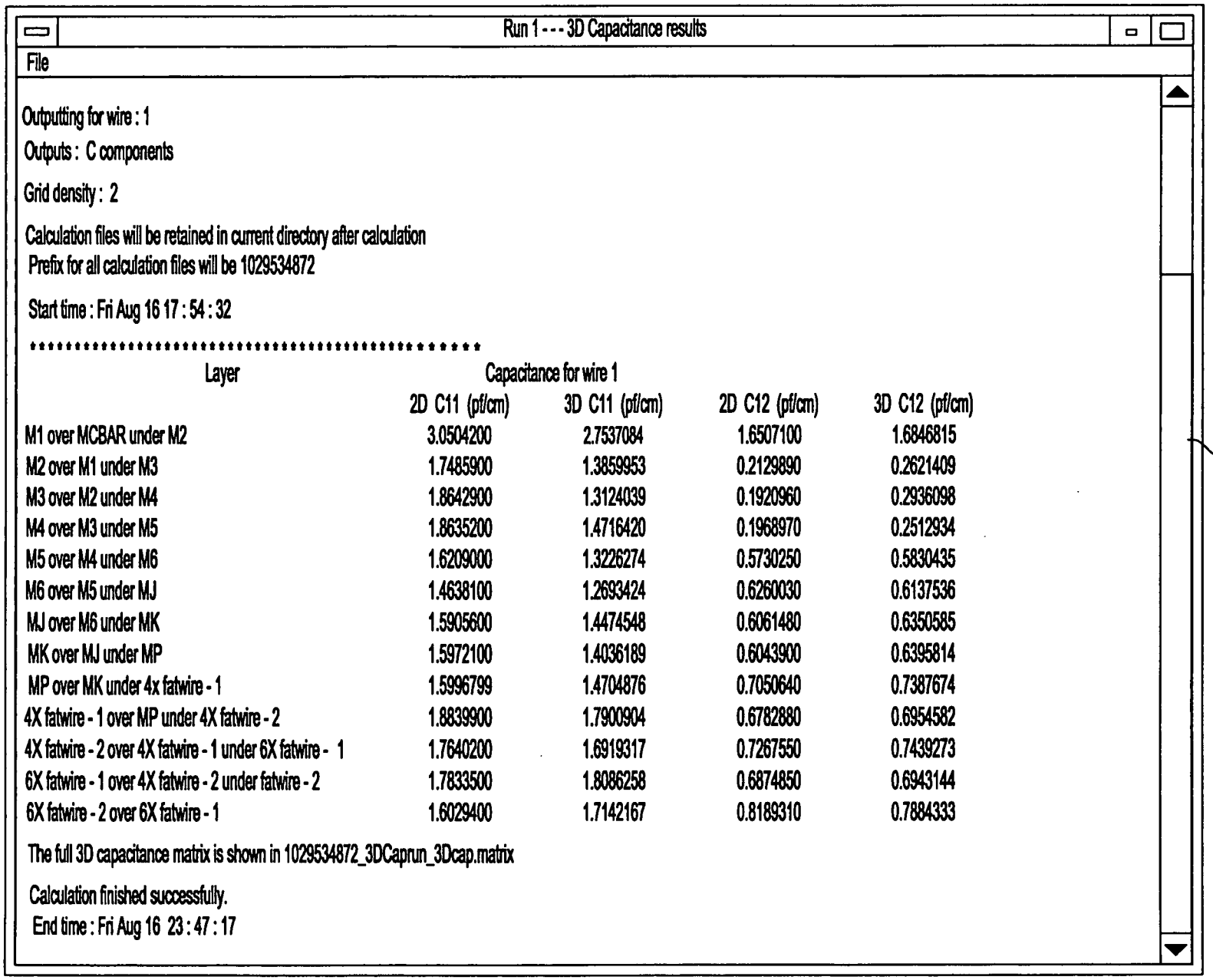

Run 1 --- 3D Capacitance results
File
Outputting for wire : 1
Outputs : C components
Grid density : 2
Calculation files will be retained in current directory after calculation
Prefix for all calculation files will be 1029534872
Start time : Fri Aug 16 17 : 54 : 32
****
Layer
Capacitance for wire 1
2D C11 (pf/cm)
3D C11 (pf/cm)
2D C12 (pf/cm)
3D C12 (pf/cm)
M1 over MCBAR under M2 3.0504200 2.7537084 1.6507100 1.6846815
M2 over M1 under M3 1.7485900 1.3859953 0.2129890 0.2621409
M3 over M2 under M4 1.8642900 1.3124039 0.1920960 0.2936098
M4 over M3 under M5 1.8635200 1.4716420 0.1968970 0.2512934
M5 over M4 under M6 1.6209000 1.3226274 0.5730250 0.5830435
M6 over M5 under MJ 1.4638100 1.2693424 0.6260030 0.6137536
MJ over M6 under MK 1.5905600 1.4474548 0.6061480 0.6350585
MK over MJ under MP 1.5972100 1.4036189 0.6043900 0.6395814
MP over MK under 4x fatwire - 1 1.5996799 1.4704876 0.7050640 0.7387674
4X fatwire - 1 over MP under 4X fatwire - 2 1.8839900 1.7900904 0.6782880 0.6954582
4X fatwire - 2 over 4X fatwire - 1 under 6X fatwire - 1 1.7640200 1.6919317 0.7267550 0.7439273
6X fatwire - 1 over 4X fatwire - 2 under fatwire - 2 1.7833500 1.8086258 0.6874850 0.6943144
6X fatwire - 2 over 6X fatwire - 1 1.6029400 1.7142167 0.8189310 0.7884333
The full 3D capacitance matrix is shown in 1029534872_3DCaprun_3Dcap.matrix
Calculation finished successfully.
End time : Fri Aug 16 23 : 47 : 17
142

FIG.4C

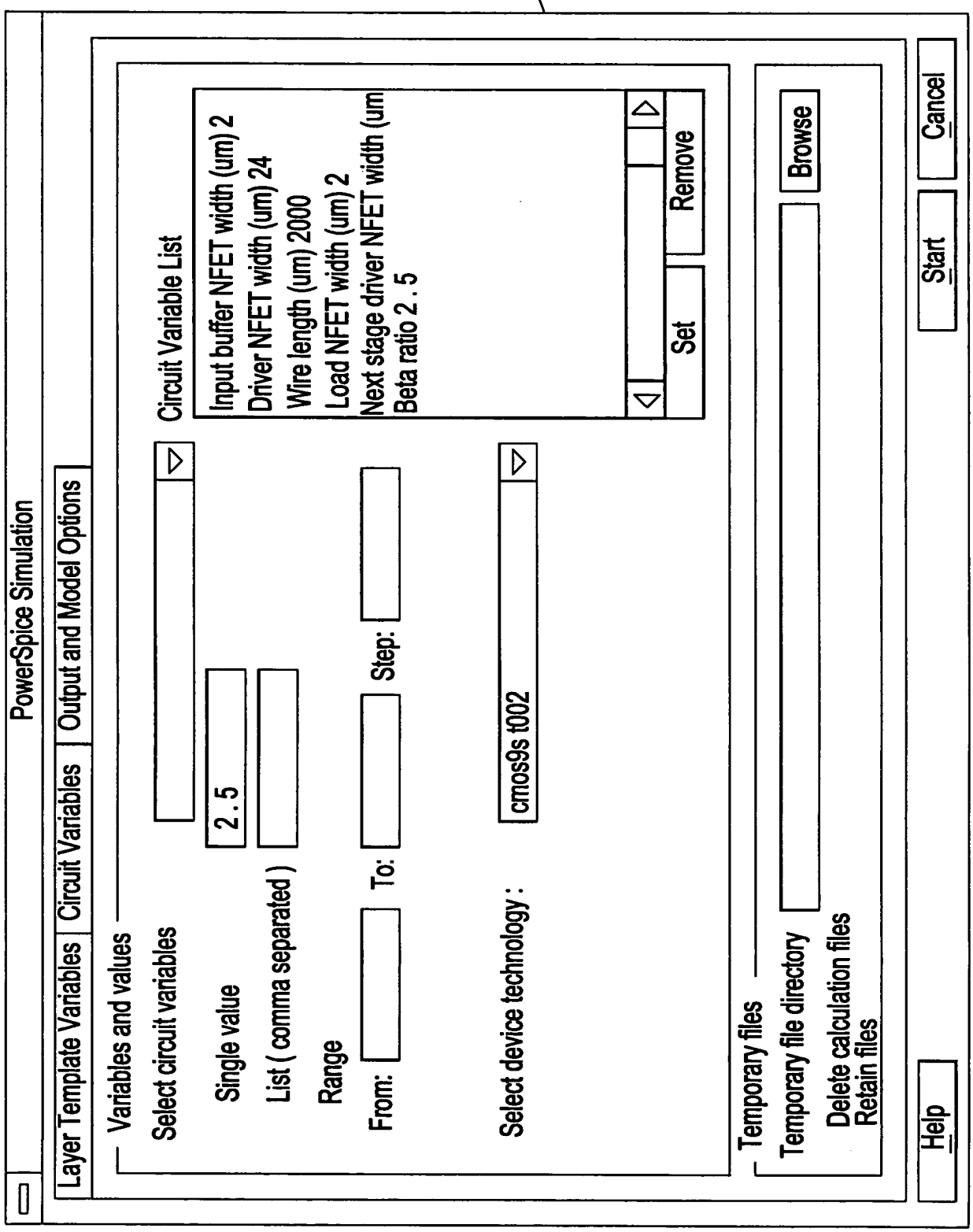

PowerSpice Simulation
Layer Template Variables
Circuit Variables
Output and Model Options
Variables and values
Select circuit variables
Single value
2.5
List (comma separated)
Range
From:
To:
Step:
Select device technology :
cmos9s t002
Circuit Variable List
Input buffer NFET width (um) 2
Driver NFET width (um) 24
Wire length (um) 2000
Load NFET width (um) 2
Next stage driver NFET width (um
Beta ratio 2 . 5
Set
Remove
Temporary files
Temporary file directory
Browse
Delete calculation files
Retain files
Help
Start
Cancel
150

FIG.5A

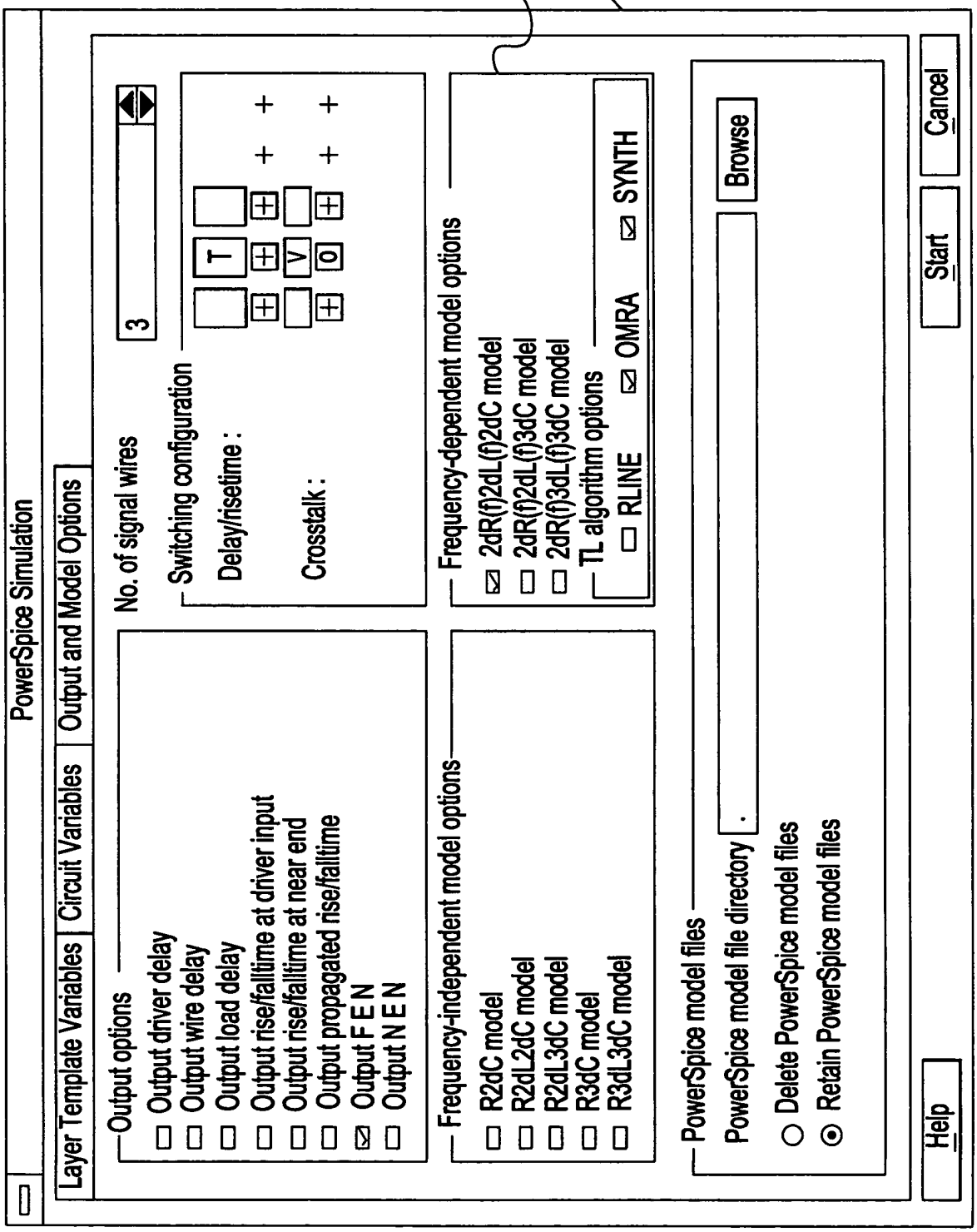

PowerSpice Simulation
Layer Template Variables
Circuit Variables
Output and Model Options
Output options
Output driver delay
Output wire delay
Output load delay
Output rise/falltime at driver input
Output rise/falltime at near end
Output propagated rise/falltime
Output F E N
Output N E N
No. of signal wires
3
Switching configuration
Delay/risetime :
Crosstalk :
T
V
0
Frequency-dependent model options
2dR(f)2dL(f)2dC model
2dR(f)2dL(f)3dC model
2dR(f)3dL(f)3dC model
TL algorithm options
RLINE
OMRA
SYNTH
Frequency-independent model options
R2dC model
R2dL2dC model
R2dL3dC model
R3dC model
R3dL3dC model
PowerSpice model files
PowerSpice model file directory
.
Browse
Delete PowerSpice model files
Retain PowerSpice model files
Help
Start
Cancel
153
152

FIG.5B

FIG.6A

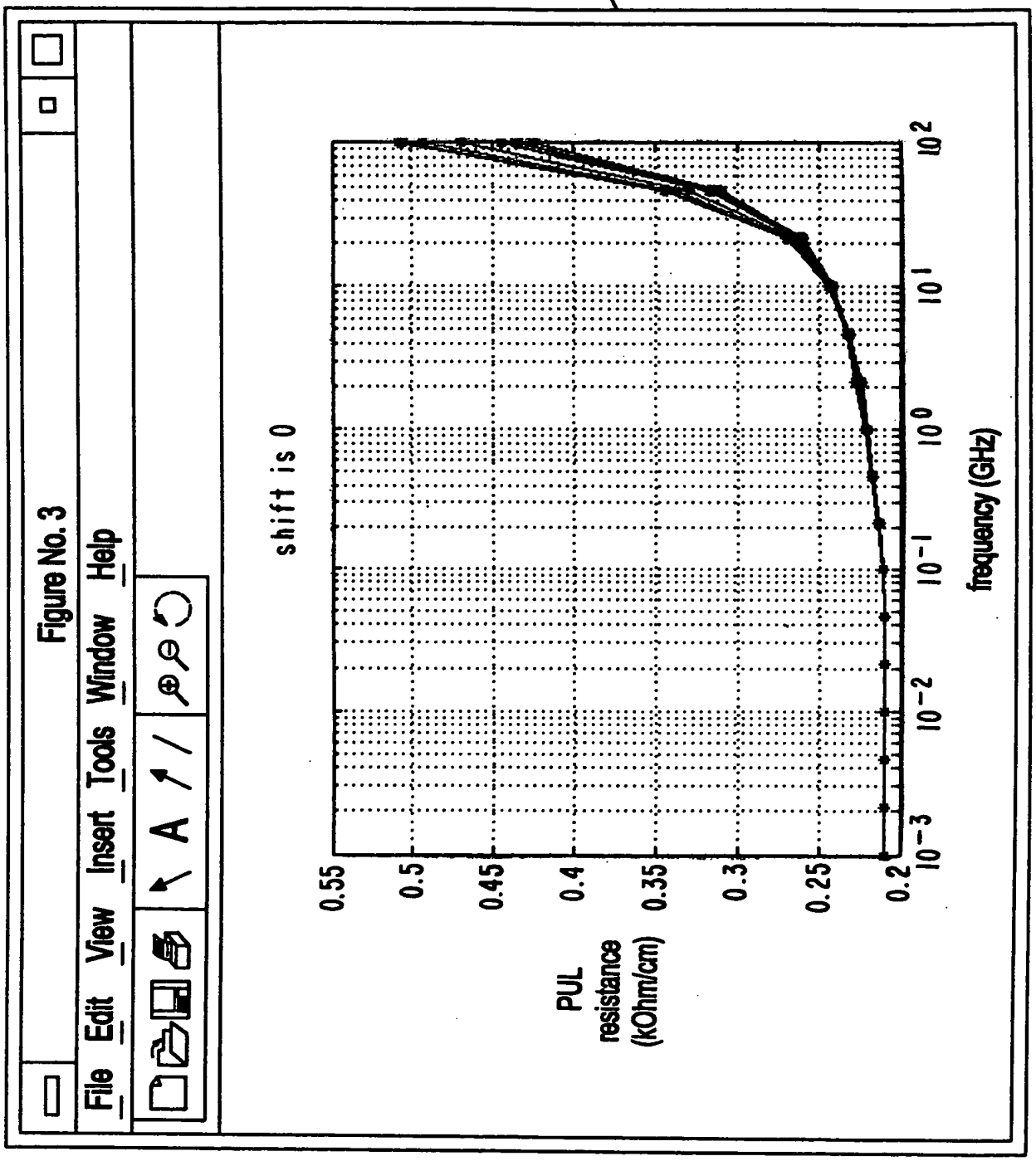
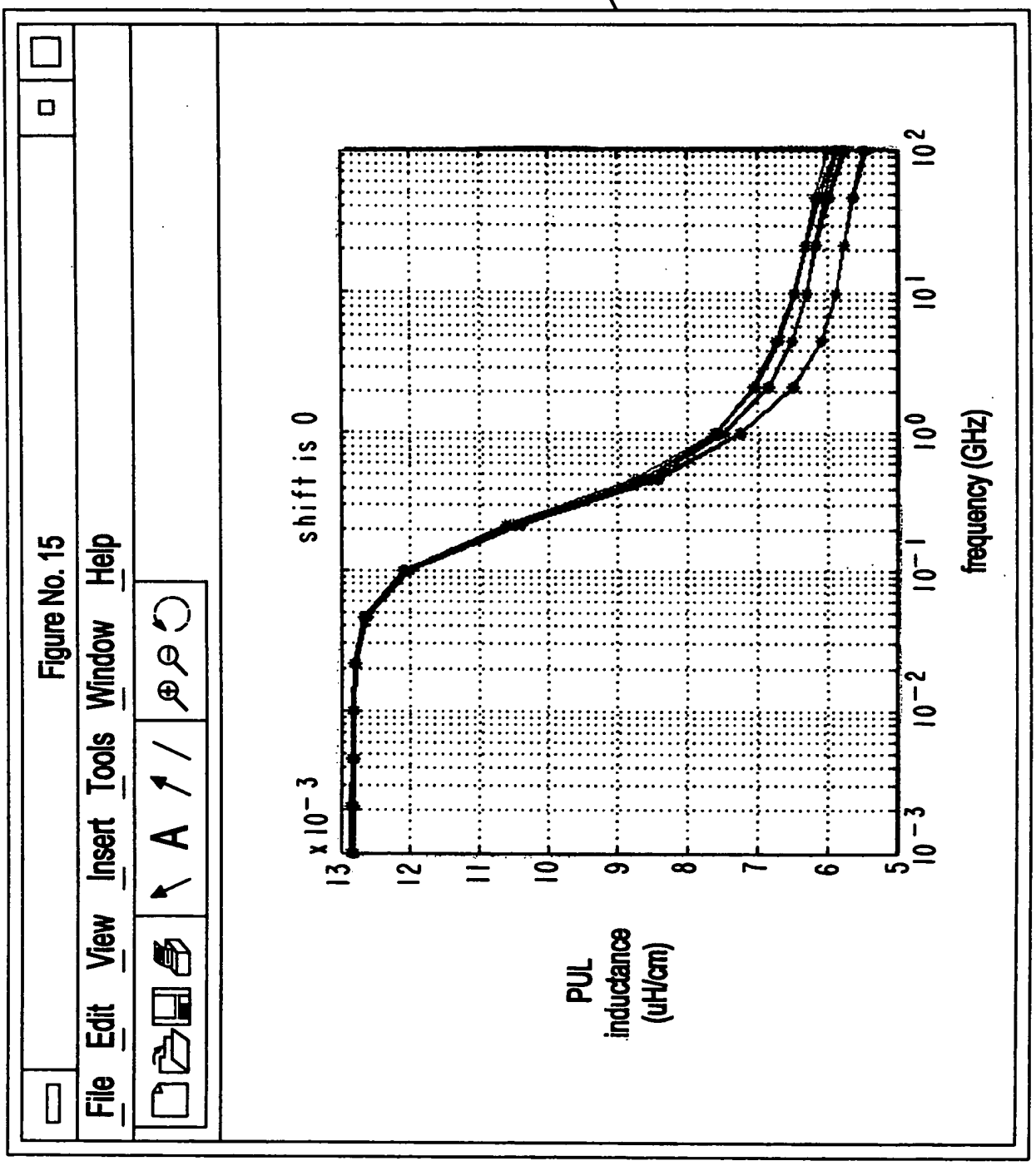

154
Figure No. 3
File Edit View Insert Tools Window Help
shift is 0
PUL resistance (kOhm/cm)
0.55
0.5
0.45
0.4
0.35
0.3
0.25
0.2
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
frequency (GHz)

FIG.6B


156
Figure No. 15
File Edit View Insert Tools Window Help
shift is 0
x 10 − 3
13
12
11
10
9
8
7
6
5
PUL inductance (uH/cm)
10 − 3
10 − 2
10 − 1
10 0
10 1
10 2
frequency (GHz)

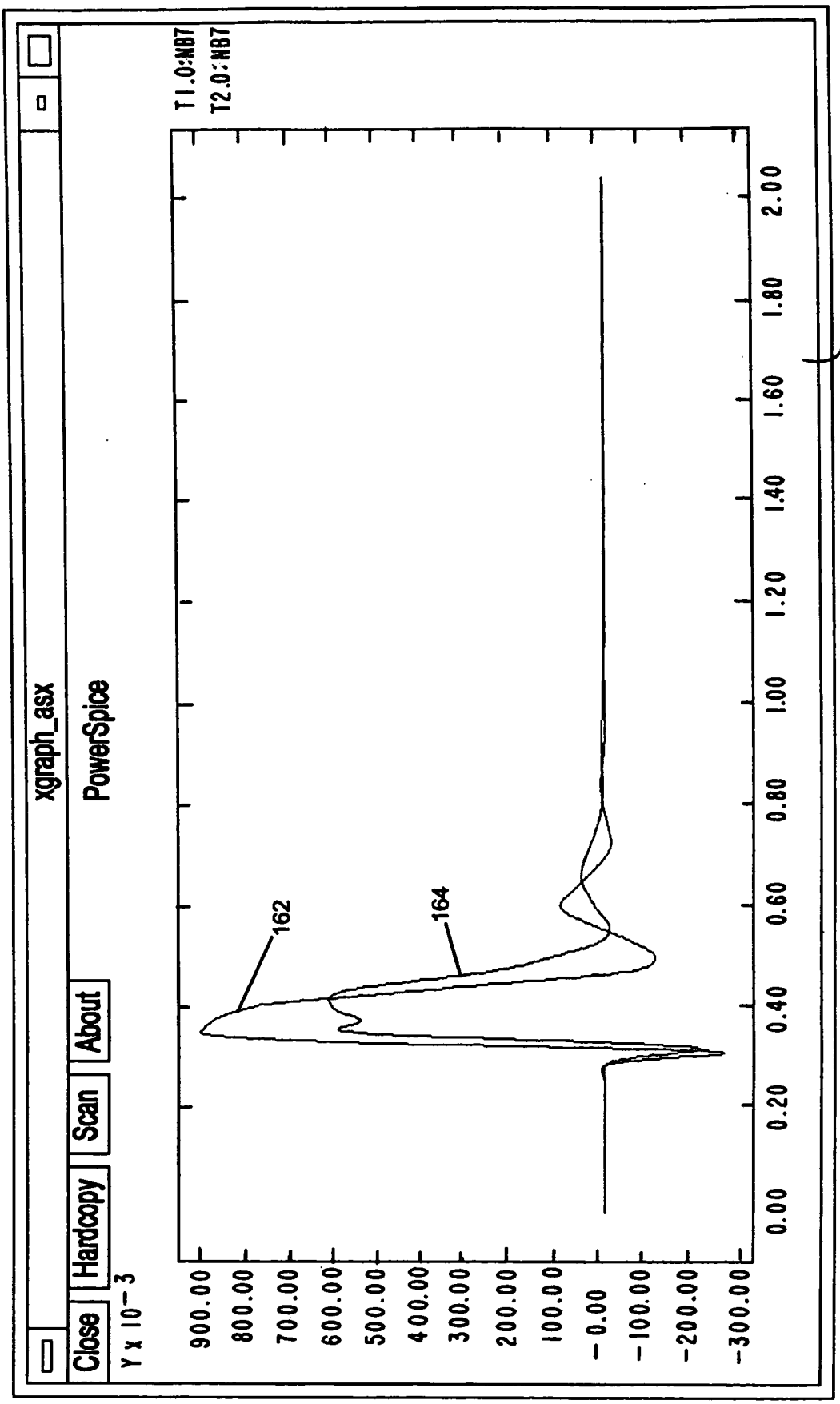

xgraph_asx
Close
Hardcopy
Scan
About
PowerSpice
Y x 10−3
T1.0:NB7
T2.0:NB7
900.00
800.00
700.00
600.00
500.00
400.00
300.00
200.00
100.00
−0.00
−100.00
−200.00
−300.00
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60
1.80
2.00
162
164
160

FIG.7